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IS 11169-2 (1989): Steels for cold heading/cold extrusion,
Part 2: Stainless steel [MTD 16: Alloy Steels and Forgings]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

**STEELS FOR COLD HEADING/COLD
EXTRUSION APPLICATIONS —
SPECIFICATION**

PART 2 STAINLESS STEELS

भारतीय मानक

अतप्त शीर्षन / अतप्त बहिर्वेधन प्रयोग के लिए इस्पात — विशिष्ट

भाग 2 स्टेनलेस इस्पात

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NEW DELHI 110002**

FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards on 25 May 1989, after the draft finalized by the Alloy Steels and Special Steels Sectional Committee had been approved by the Structural and Metals Division Council.

IS 11169 (Part 1) Steels for cold heading/cold extrusion applications : Part 1 Wrought carbon and low alloy steels was issued in 1984. This standard covers:

- a) Carbon steels,
- b) Alloy steels,
- c) Carbon steels with boron, and
- d) Alloy steels with boron.

In view of the special requirements of stainless steels for cold heading/cold extrusion application, it was recommended by the committee to treat this topic as a separate part of the standard.

This standard is exclusively covering the application of stainless steels for cold heading processes. This standard (Part 2) has been prepared keeping in view that the particulars to be specified while ordering the steel are as per (Part 1) of this standard.

In the preparation of this standard (Part 2), manufacturing and trade practices followed in the country in this field have been kept in view. Also due weightage has been given to the need for international coordination in standardization. The following Indian and international standards have been referred:

IS 1570 (Part 5) : 1985	Schedules for wrought steels : Part 5 Stainless and heat-resisting steels (<i>first revision</i>)
IS 6527 : 1972	Stainless steel wire rod
ISO 4954 : 1979	Steels for cold heading and cold extruding
DIN 1654 (Part 5) : 1980	Steels for cold heading and cold extruding, technical conditions of delivery for stainless steels. Deutsches Institut für Normung (DIN).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

STEELS FOR COLD HEADING/COLD EXTRUSION APPLICATIONS — SPECIFICATION

PART 2 STAINLESS STEELS

1 SCOPE

1.1 This standard (Part 2) covers the requirements for wrought stainless steels intended for cold heading and are delivered as wires, wire rods or bars. It applies to ferritic, martensitic and austenitic stainless steels.

2 REFERENCES

2.1 The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	Title
IS 228 (in parts)	Methods of chemical analysis of steels (<i>second revision</i>)
IS 2049 : 1978	Colour code for the identification of wrought steels for general engineering purposes (<i>first revision</i>)
IS 3711 : 1966	Method for selection and preparation of samples and test pieces for mechanical tests for wrought steels
IS 8910 : 1978	General technical delivery requirements for steel and steel products

3 SUPPLY OF MATERIAL

3.1 General requirements relating to the supply of material shall conform to IS 8910 : 1978. Steel covered by the standard shall be ordered and delivered on any one of the following basis:

- a) Chemical composition, or
- b) Chemical composition and mechanical properties.

4 REQUIREMENT CLASSES

4.1 When steel is ordered in accordance with this standard, one of the three classes (*see* Table 1) shall be agreed at the time of enquiry.

Table 1 Summary of Quality Requirement Classes

SI No.	Quality Requirement Type	Requirement Class		
		1	2	3
i)	Chemical composition:			
	a) Ladle analysis	×	×	×
	b) Check analysis	×	—	—
ii)	Mechanical properties:			
	a) Supply condition*	×	×	×
	b) At room temperature†	—	×	×
	c) At temperature from 50 to 300°C†	—	—	—

*As per delivery conditions covered under 10.
†In the heat treatment conditions specified in Tables 5 and 6.

5 MANUFACTURE

5.1 Unless otherwise agreed to in the order, the processes used in making the steel are left to the discretion of the manufacturer. When so desired, the purchaser shall be informed of the steel making process.

6 CHEMICAL COMPOSITION

6.1 The ladle analysis of different grades of steel when carried out either in accordance with relevant parts of IS 228 or any other established instrumental/chemical method should conform to the values given in Table 2. In case of dispute, the procedure given in various parts of IS 228 (in parts) shall be the referee method.

6.1.1 For cases where the methods of chemical analysis are not covered in any part of IS 228, mutually agreed methods may be adopted by the manufacturer and the customer.

Table 2 Chemical Composition (Applicable to Ladle Analysis)

(Clauses 6.1, 6.2 and 12.1)

Sl No.	Steel Grade	Elements, Percent								
		Carbon (C)	Silicon (Si)	Manganese (Mn) Max	Nickel (Ni)	Chromium (Cr)	Molybdenum (Mo)	Sulphur (S) Max	Phosphorus (P) Max	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	Ferritic steel ×07Cr17	0.12 Max	1.0	1.0	—	16.0-18.0	—	0.030	0.045	—
ii)	Martensitic steel ×12Cr12	0.08-0.15	1.0	1.0	—	11.5-13.5	—	0.030	0.045	—
iii)	Austenitic steel ×02Cr19Ni10	0.030 Max	1.0	2.0	8.0-12.0	17.5-20.0	—	0.030	0.045	—
	×04Cr19Ni10	0.08 Max	1.0	2.0	10.5-12.0	17.0-20.0	—	0.030	0.045	—
	×04Cr17Ni12Mo2	0.08 Max	1.0	2.0	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	—
	×04Cr18Ni10Ti	0.08 Max	1.0	2.0	9.0-12.0	17.0-19.0	—	0.030	0.045	Ti=5×C -0.80
	×04Cr17Ni12Mo2Ti	0.08 Max	1.0	2.0	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	Ti=5×C -0.80
	×02Cr17Ni12Mo2	0.030 Max	1.0	2.0	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	—

6.2 The permissible variation in the case of product analysis from the limits specified in Table 2 shall be according to Table 3.

Table 3 Permissible Deviation in Check Analysis

(Clauses 6.2 and 12.1)

Constituent	Permissible Content in Cast Analysis, Percent		Permissible Deviation (Percent)
	Over	Up to and Including	
Carbon	— 0.03	0.03 0.15	± 0.005 ± 0.01
Silicon	—	1.00	+ 0.05
Manganese	— 1.00	1.0 2.0	+ 0.03 ± 0.04
Chromium	11.5	20	± 0.20
Molybdenum	2.0	3.0	± 0.10
Nickel	8.0	14.0	± 0.15
Sulphur	—	0.03	+ 0.005
Phosphorus	—	0.045	+ 0.005
Titanium	0.40	0.80	± 0.05

7 FREEDOM FROM DEFECTS

7.1 The material shall be free from harmful internal and surface defects.

8 MECHANICAL PROPERTIES

8.1 For all steels, which are ordered, shall be of the treatment conditions indicated in 10, the maximum values for tensile and yield strength (TS) and the minimum value for reduction of area (RA) as specified in Table 4 shall apply.

8.2 For all steels which are ordered in accordance with the requirements of Class 2, the mechanical properties specified in Table 5 shall apply for reference test pieces which are heat treated in accordance with the recommendations of Table 6.

9 CORROSION RESISTANCE

9.1 The performance of stainless steels under various conditions of chemical attack cannot be characterized by test values as general norms. If desired, a corrosion test shall be agreed to at the time of enquiry and order.

10 TREATMENT CONDITION OF DELIVERY

10.0 The steels shall be usually delivered in one of the following treatment conditions unless specifically agreed to at the time of enquiry/order.

Table 4 Treatment

(Clause 8.1)

Steel Grade	Treatment for Ferritic and Martensitic Grades					
	AC or AC + P : C + AC : C + AC + LC					
	Treatment for Austenitic Grades					
	Q or Q+P		C+Q		E+Q+LC	
	Tensile Strength MPa Max	Reduction in Area Percent Min	Tensile Strength MPa Max	Reduction in Area Percent Min	Tensile Strength MPa Max	Reduction in Area Percent Min
×07Cr17	570	63	570	60	620	65
×12Cr12	600	60	600	62	640	62
×02Cr19Ni10	630	55	630	55	680	55
×04Cr19Ni10	680	55	680	55	730	55
×04Cr17Ni12Mo2	680	55	680	55	730	55
×04Cr18Ni10Ti2	680	55	680	55	730	55
×04Cr17Ni12Mo2Ti	680	55	680	55	730	55
×02Cr17Ni12Mo2	680	55	680	55	730	55

Table 5 Mechanical Properties of Steels as per Heat Treatment Condition in Table 6

(Clause 8.2)

Steel Grade		Heat Treatment Condition	Yield Point or 0.2% Proof Stress, MPa Min	Tensile Strength T.S., MPa	Elongation Percent (Min) G.L. = $5.65 \sqrt{S_0}$	Impact U Notch=5 mm J, Min
Ferritic	×07Cr17	Annealed	270	450-600	20	—
Martensitic	×12Cr12	Quenched & Tempered	450	600-750	18	50
Austenitic	×02Cr19Ni10	Quenched	175	450-700	50	60
	×04Cr19Ni10		185	500-700	50	60
	×04Cr17Ni12Mo2		205	500-700	45	60
	×04Cr18Ni10Ti		205	500-750	40	60
	×04Cr17Ni12Mo2Ti		225	500-750	40	60
	×02Cr17Ni12Mo2		225	500-750	40	60

Table 6 Heat Treatment Condition

(Clause 8.2)

Steel Grade		Annealing		Quenching		Tempering Temp °C
		Temp °C	Cooling Medium	Temp °C	Cooling Medium	
Ferritic	×07Cr17	750-850	Air/water	—	—	—
Martensitic	×12Cr12	700-780	Furnace or Air	950-1 000	Oil or Air	750-850
Austenitic	×02Cr19Ni10	—	—	1 000-1 050	—	—
	×04Cr19Ni10	—	—	1 000-1 050	—	—
	×04Cr17Ni12Mo2	—	—	1 050-1 100	—	—
	×04Cr18Ni10Ti	—	—	1 020-1 070	—	—
	×04Cr17Ni12Mo2Ti	—	—	1 050-1 100	—	—
	×02Cr17Ni12Mo2	—	—	1 050-1 100	—	—

10.1 Ferritic and Martensitic Steels

Annealed (spheroidization of carbides)	AC
Annealed (spheroidized) and peeled	AC+P
Cold drawn and annealed (spheroidized)	C+AC
Cold drawn, annealed (spheroidized) and lightly cold reduced (for example, with reduction of 5 percent)	C+AC+LC

10.2 Austenitic Steels

Quenched	Q
Quenched and peeled	Q+P
Cold drawn and quenched	C+Q
Cold drawn, quenched and lightly cold reduced (for example, with reduction of 5 percent)	C+Q+LC

11 SAMPLING**11.1 Sampling for Chemical Analysis**

The ladle analysis shall be supplied by the producer. If a product analysis is required by the purchaser, at least one sample product shall be taken from each cast.

11.2 Sampling for Mechanical Properties

If required by the purchaser, one sample product shall be taken from each size grouping of each heat-treated batch for testing. If the product is continuously heat-treated, the sampling for mechanical tests shall be as agreed to between the purchaser and the manufacturer.

General conditions for selection and preparation of samples and test pieces shall be in accordance with IS 3711 : 1966.

12 RETESTS**12.1 Retest for Product Analysis**

If the results of product analysis do not meet the composition requirements given in Tables 2 and 3, unless otherwise agreed to between the purchaser and the manufacturer, two new samples shall be taken on different pieces from the same cast. Should the two analysis satisfy the requirements, the lot represented shall be accepted. Should either of the tests fail, the material shall be taken as not complying with this standard.

12.2 Retest for Mechanical Tests in the Heat Treated Condition

If the samples selected fail to meet the requirements stipulated, two further samples shall be selected from the same heat treatment batch or lot. The consignment shall be considered to conform to the requirements if both the additional tests are satisfactory. If either of the samples fails, the manufacturer shall have the right, if he so desires in case of heat-treated material, to reheat-treat the product in any suitable manner before two fresh samples are taken for testing. If the two tests satisfy the requirements of this standard, the lot represented shall be accepted and if either of the samples fails, the material shall be taken as not complying with this standard.

13 PACKING OF MATERIALS AND MARKING

13.1 Steel bars shall be suitably bundled. A metal tag giving the following information shall be attached to each bundle:

- a) Name or trade-mark of the manufacturer,
- b) Steel grade, and
- c) The cast number or any other identification mark by which the steel can be traced to the cast and heat treatment batch from which it was made.

13.2 The colour scheme specified in IS 2049 : 1978 or as required by the purchaser may be adopted to mark the grade of the material.

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